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Histopathological studies on the tissue test in experimental ascaridiosis of chickens

Studia histopatologiczne nad odczynem tkankowym w doświadczalnej glistnicy kurcząt

One of the most common parasitic diseases of the domestic birds of the order *Galliformes,* besides coccidiosis and syngamosis is ascaridiosis, caused by *Ascaridia galli* Schrank, 1788. As shown by statistical data the percentage of invasion of the poultry in large farms is about 40.5, but in small flocks this percentage is somewhat lower. The author's observation made in the poultry slaughter house in Lublin indicate that in 300 hens of various origin *Ascaridia galli* occurred in 48 cases (16%). The number of parasites in one individual fluctuated from 2 — 10 specimens.

No records are available on the mass occurrence of the discussed parasites in Lublin Palatinate neither were there noted invasions of a fatal course except isolated cases. Nevertheless ascariasis is among the breeding poultry very common what is proved on post-mortem examinations of birds directed to the Department of Pathological Anatomy, Veterinary Faculty, Agricultural College in Lublin, where dissections of the carcasses were conducted in 1948 — 1958, and ascariasis was diagnosed in many cases.

In the present work it was aimed to analyse the morphological changes found in chickens Sussex, invaded experimentally with *Ascaridia galli.* The macroscopic and microscopic methods were used and particular stress was laid on the reaction of the reticulo-endothelial system.

In the course of the present work a number of tests, based on parasitological, bacteriological and serological methods were performed and employed to serve as tests to corroborate the experiments.

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Material and methods

In the present experiment 50 Sussex chickens were used; the birds were arranged into two groups, each numbering 25 chickens. The chickens of the I group were invaded at the age of 4 weeks (in May), the birds in the II group were invaded at the age of 8 weeks (in June). In each of the groups 2 chickens were not invaded to serve as controls.

The material obtained from the Department of Parasitology of the Veterinary Institute in Puławy was fully invasive.

Invasion was produced by the administration of the invasive eggs by means of a stomach tube into the crop of bird. In this way every chicken of the I group received about 150 eggs, in the II group — about 300 eggs.

Preliminary to invasion the chickens were weighed. The mean weight of a chicken of the I group was 300 g, that of the II group about 400 g. All chickens were in a very good condition.

After 4 days one chicken was killed every 24 hours and the carcasses were dissected. The alimentary tract was divided into sections: duodenum, jejunum, ileum and caeca with the terminal part. The sections were rinsed under tap water under pressure and with warm water. The water used for rinsing was examined for the larvae. The intestinal mucous membrane was examined macroscopically and by the use of the stereoscopic magnifying glass.

After the taking of the slides for microscopic examination the mucus in smears was examined to find the eventual larvae adhering to the mucous membrane.

Over 750 histological preparates were made. The microphotographs were taken by Jerzy Pacewicz from the Veterinary Institute in Puławy.

From the dissected birds samples were sent for bacteriological control to the District Department of Veterinary Hygiene in Lublin.

From several chickens of the two groups blood was collected and

with the sera a precipitation test* was run against the antigen obtained from the larvae of *Ascaris galli* on the presence of specific antibodies, and against the control antigen from *Raillietina cesticillus* Molin.

Clinical observations of the two groups did not produce interesting results. Only in the chickens of the I group, after 10 days following invasion, there could be observed drowsiness and diminishing of appetite. This state changed after 3 days. It was suspected that the observed symptoms remained in direct relation to the atmospheric changes, because at that time a sudden drop of temperature of the air took place, the dwellings became cooler and the birds were exposed to cold. Therefore the mentioned symptoms were not connected with the penetration of the larvae into the intestinal mucous membrane and the general reaction of the organism of the birds.

GROUP I

Results of dissections

Cases 1 — 6: Duodenum. Considerable amount of dense, gummy mucus, sticking together the villi, resistant to the rinsing with running water. As through a velvety, slaty grey mucous membrane are visible numerous, translucent small lymph noduli, which form sometimes tape-like prominences along the axis of the intestine.

Jejunum and ileum: In the initial section of the jejunum a considerable amount of mucus, the amount of which diminishes significantly in the ileum. The mucous membrane is pale and the dispersed lymph noduli are clearly marked.

Caeca: The mucous membrane of the caeca pale and folded, covered with a scanty amount of mucus. At the entrance to the caeca the lymphatic apparatus, called sometimes tonsilla coecalis, is distinctly marked, of a slaty-grey colour.

Cases 7 — 13. Duodenum and jejunum: In the distal part of duodenum and in the initial part of jejunum there are in the mucous membrane numerous, small, superficial ecchymoses which

* Serological examinations were conducted with the assistance of Dr. Adolf Koślak from The District Departament of Veterinary Hygiene and in this place I should like to convey him my gratitude.

occupy the space of several villi and sometimes penetrate into the deeper layers of the mucous membrane. No larvae were found in the mucous membrane, even after the saturation of the epithelium with the mucous secretion with eosine and mucocarmine.

Ileum: In the mucous membrane scantily dispersed ecchymoses are arranged similarly as in duodenum and jejunum. In one case the ecchymoses were seen translucent thraugh the serous membrane.

Caeca: The mucous membrane folded and pale, the tonsillae caecales not enlarged, of a smooth surface.

Cases 14 — 25 (together with controls). Duodenum: In the mucous membrane, besides the considerable amount of mucus and isolated small ecchymoses, no other lesions are observed.

Jejunum: Significantly marked the lymphatic system, the noduli fairly large, frequently arranged along the intestine, grey and pale, sometimes surrounded by an area of hyperaemia. Considerably less mucus.

Ileum: The mucous membrane pale, covered with a small amount of mucus. The lymph noduli single, well outlined.

In the case 17 the Meckel's diverticulum distinctly enlarged and opened, its mucous membrane dry, porous, somewhat thickened, shows some hyperplasia and is intensively pink in colour.

Caeca: No visible lesions are observed.

As the result of postmortem examinations of the parenchymatous organs it was found that no major deviations from the normal state were noted.

Parasitological control

In water collected after the rinsing of duodenum of the cases 9, 10, 11 and 12 (14 — 17 day following invasion) the larvae of *Ascaridia galli* were found in numbers ranging from 2 — 5 specimens. In warm water the larvae exhibited a lively screw-pendulous movement.

In the smear of the mucus collected from the duodenum no larvae were found, but in cases 6 — 12 their presence was proved in the sections of the jejunum and partly ileum. On the average there occurred 4 specimens of parasites.

In the case 17 (considerably enlarged Meckel's diverticulum) there were in the scrapings collected from the mucous membrane 10 larvae of various length.

In water collected after rinsing the intestines of the remaining cases, single larvae were found only, mainly from jejunum.

The weight of the chicken last invaded (No. 23) was after killing 450 g, but the weight of two control chickens, killed simultaneously, was about 600 g. Because the chickens remained under identical conditions, this fact constitutes a corroboration of observations made by many investigators that the parasitic invasion, even of a low intensity, is not an indifferent phenomenon to the organism and influences in a various way the processes of assimilation and dissimilation.

Bacteriological control conducted at the District Department of Veterinary Hygiene proved in the 5 case the presence of *Salmonella gallinarum* (postmortem examination was negative). The cultivation method in the remaining cases gave negative results.

Serological control (precipitation):

Serum of chicken no.	Antigen from *Ascaridia galli*	Control antigen from *Raillietina cesticillus*
6 after 5 min. in 40°C	−	−
8 „ „ „ „	+	−
10 „ „ „ „	+ −	−
11 „ „ „ „	+ +	+ −
12 „ „ „ „	+	−
13 „ „ „ „	+ −	−
14 „ 2 „ „	+ +	+ −
15 „ „ „ „	+	−
17 „ „ „ „	+ +	+
20 „ 5—10 „ „	+ −	+ −
21 „ „ „ „	−	−
24 control „	+ −	+ −
25 „ „	−	−

Microscopic examination

In the histological preparations made from the parenchymatous organs: heart, liver, spleen, and kidneys, in several cases also from the brain — no significant morphological changes were found.

Case 1. Duodenum, jejunum and ileum: Among the normal cylindrical epithelium numerous goblets cells filled with mucus which covers the surface of the villi. The number of goblet cells dimini-

shes in jejunum and ileum, the content of mucus decreases, the cells are barely visible, darkly stained. The proper layer of the mucous membrane is infiltrated with lymphocytes.

Caeca: In tonsilla caecalis numerous lymphoblasts and lymphocytes. In the proper layer there are centres of hyperplasia which raise the mucous membrane and communicate with the lumen of the intestine.

Cases 2 and 3. Duodenum: Locally in the mucous membrane there appears a distinct stroma of the proper layer of the villi. In Lieberkühn's glands lymphocytary infiltrations.

Cases 4, 5 and 6.: Duodenum: The villi enlarged; reticular stroma of the proper layer distinct, infiltrated locally with lymphoblasts and lymphocytes, here and there are visible preudoeosinophils. The epithelium frequently injured, sometimes the goblet cells, darkly stained, look like inactive. Jejunum: In the submucous membrane small erythrocytes extravasations on a limited distance. A distinct hyperplasia of the lymphatic noduli. On the surface of the low and flimsy villi a small amount of mucus, the goblet cells small, opaque, look like dim. In the submucous membrane there are in few places small aggregates of pseudoeosinophils.

Case 7. Duodenum: The intestinal villi swollen, adhere together, sometimes form a band infiltrated with an copious lymphocytary infiltration. On the surface the cells stain badly, the structure of the cells of the villi barely visible, liquifaction of the epithelium, necrobiosis of the proper layer and therefore locally only the cellular nuclei are seen. After the separation of the necrotic parts of the mucous membrane there appear shallow ulcers. There appear also focal extravasations which extend to the muscular layer.

Jejunum and ileum: Considerable hyperplasia of the lymphatic noduli, bright hyperplastic centres filled with lymphoblasts and in the mucous membrane of the jejunum small extravasations of blood cells.

Case 8. Duodenum: A considerable uniform oedema of the villi. In the reticular stroma of the proper layer there appears a hyperplasia of large cells, having a pink coloured cytoplasm and large oval nucleus of a distinct chromatin structure. These cells, as histiocytes, reach the submucous membrane and extend also to the intestinal lumen. In the copious mucous secretion, which covers the surface of the injured villi, there are visible necrotic cells of

the epithelium. On the level of 1/3 of the height of villi there are fragments of the cuticle of larvae surrounded by an infiltration composed of lymphocytes and pseudoeosinophils.

Jejunum and ileum: In the mucous membrane of jejunum the discplaced villi undergo partly colliquative necrosis. Among the cellular infiltration near the basis of the villi there appear fibroblasts. A similar picture is seen in the ileum, but the lesions are limited to some sections only. In caeca the lymphocytary infiltrations occur locally in the mucous membrane.

Case 9. Duodenum and jejunum: Lymphocytary hyperplasia observed uniformly in the whole mucous membrane. The superficial layer of necrotic cells separated from the rest and surrounded by a demarcation wall of cellular infiltration. Similar changes are observed in the jejunum where the small extravasations of blood cells are lost in the mass of infiltration cells. In further sections of the alimentary tract the lesions subside distinctly.

Case 10. Duodenum and jejunum: In the terminal part of duodenum and initial part of jejunum a distinct cellular infiltration in the proper layer. It consits mainly of lymphocytes and lymphoblasts and is connected with the lymphatic noduli. It extends to the neighbourhood of the necrobiotic mucous membrane. In some places the necrotic tissues are separated from the intestine. At the basis of the villi, close to the muscle layer of the proper layer, there occur small foci, lightly stained, surrounded by a scanty cellular infiltration in which the pseudoeosinophils prevail. Fibroblasts occur here and there. The epithelial cells are also swollen, opaque, or very bright, looking like affected with mucous degeneration in unaffected part of the jejunum. In one place of the jejunum there was a superficially located centre, surrounded by a lymphocytary--pseudoeosinophilic infiltration, in the interior of which fragments of parasite were present.

Case 11. Duodenum: As in case 10.

Jejunum: Infiltration composed of pseudoeosinophils extends over several necrobiotic villi and reaches the lumen of the intestine. Between the damaged villi there are the tissues of the parasite in a state of break-down. The Lieberkühn's glands are darkly stained and infiltrated with lymphocytes and histiocytes.

Cases 12 and 13. Duodenum: The structure of the mucous membrane completely obliterated. In its place a copious lymphocytary

infiltration and extravasation of blood cells. Few histiocytes infiltration and extravasation of blood cells. Few histiocytes and fibroblasts. In the case 13 there are observed sharply defined small necrotic centres and fragments of the parasite surrounded by a cellular infiltration composed mainly of pseudoeosinophils.

Jejunum: Similar as in case 13. Beside this also fairly numerous fibroblasts displaced from the submucous membrane, which unite the degenerated villi into one band.

Ileum: Hyperplasia of the lymphatic noduli, numerous lymphoblasts as an expression of the irritation of the lymphatic system.

Case 14. At the terminal part of duodenum and initial part of jejunum the morphology of the mucous membrane obliterated by the swollen villi and cellular hyperplasia, histiocytary mainly. The reticular structure of villi and stellar cells indicate mucoid degeneration. In one place of this section of the alimentary tract there occurred in the submucous membrane a medium extravasation of erythrocytes and fibroblastic hyperplasia.

Ileum: In some places local haemorrhages caused adhesion of the villi and penetrated to the muscular and proper layers.

Cases 15 and 16. Duodenum: On the surface scanty mucus secretion containing desquamated epithelial cells and white cells.

Jejunum: Small necrotic foci are separated from the tissue; fragments of the parasite occur between the necrobiotic villi. The foci are surrounded by numerous infiltration cells, among which prevail pseudoeosinophils, lymphocytes and histiocytes. There are also observed extravasated erythrocytes.

Case 17. Duodenum and jejunum: Considerable hyperplasia of the lymphatic noduli and local histiocytary hyperplasia.

Ileum: In Meckel's diverticulum there occurs a superficial necrobiosis of the mucous membrane, histiocytary hyperplasia, pseudoeosinophilic infiltration and, above all, hyperplasia of connective tissue which surrounds the hyperplastic "neoplasmatic" glandular tissue.

Case 18 and 19. Duodenum and jejunum: The morphological structure locally obliterated; the epithelium and partly the proper layer necrobiotic. A considerable number of histiocytes and lymphocytes.

Ileum and caeca: Hyperplasia of the lymphatic noduli of a minor degree does not obliterate the morphological details of the mucous membrane.

Case 20. Locally the duodenal mucous membrane and that of the jejunum shows reticular outline of the villi and numerous stellate cells, evidence of mucoid degeneration.

Ileum: Besides lymphocytes few histiocytes and plasmatic cells.

Cases 21, 22 and 23. Duodenum as in case 20.

Jejunum: Between the loose structure of the villi fairly large amount of mucus and numerous histiocytes. Locally there occur agglomerations of pseudoeosinophils. In the proper layer of the mucous membrane occasionally fibroblasts.

Controls: Duodenum: Mucous membrane normal, epithelium preserved, villi long and free. Goblets cells well visible, in large amount, bright, large, filled with mucus.

In the proper layer the reticular stroma contains few lymphocytes, plasmatic cells and elastic fibers of a normal course; muscle fibers well stained and preserved. Lieberkühn's glands marked, the submucous layer scanty and flimsy, transversal and longitudinal muscular layers well stained.

Jejunum and ileum: Villi low and broad, lymphatic glands well marked, hyperplastic centre accentuated.

Caeca: Lymphatic apparatus well developed; mucous membrane totally preserved, modestly infiltrated with lymphocytes.

GROUP II

Results of dissections

Cases 1 — 6. Duodenum: The surface of the mucous membrane covered with dense mucus, fast adhering, resistant to rinsing under running water. At the terminal section the mucous membrane is velvety, pale and grey, covered with small haemorrhages which embrace 1 — 2 villi.

Jejunum and ileum: The mucous membrane grey-ashy, covered with scanty amount of mucus. Distinctly marked single dispersed lymphatic noduli. Locally similar haemorrhages as in the duodenum.

Caeca: In the case No. 5 the tonsilla caecalis greatly enlarged, of an uneven surface, brightly red. The mucous membrane is covered with red coloured strips and numerous foci, the size of millet, sharply defined from the surrounding tissue. The rims of the foci surrounded by a hyperaemic area. The centre of the foci is occupied by a crater filled with a caseous mass. In the remaining

cases the mucous membrane of intestines and caeca is folded, pale, covered with a modest amount of mucus.

Cases 7 — 14. Duodenum: as described in the former cases.

Jejunum and ileum: In the mucous membrane of jejunum numerous ecchymoses penetrating into the submucous membrane and enclosing several villi. The mucous membrane of the ileum is pale, velvety and covered with a modest amount of mucus.

Caeca: The lymphatic apparatus at the entrance to the caeca significantly enlarged, the "tonsilla" are swollen and hyperaemic, sometimes have a look of a cauliflower.

The mucous membrane of the caeca is on the whole pale and folded, and in the case No. 12 it contains small yellow-grey foci, the size of a pin-head, surrounded by a delicate hyperaemic ring.

Cases 15 — 23. Duodenum: In the terminal part of duodenum, besides a considerable amount of mucus and small isolated ecchymoses, no changes were observed.

Jejunum and ileum: In the slaty-grey mucous membrane there is a distinctly marked number of well developed lymphatic noduli, which unite in the middle section of the small intestine in a form of plates. Punctate ecchymoses are seen only in the mucous membrane of ileum.

Caeca: Similar picture as in the previously described cases.

Control cases No. 24 and 25. Intestines: Besides the considerable amount of mucus in the duodenum and increased hyperplasia of the lymphatic noduli in the jejunum and ileum no pathological lesions were observed.

Caeca: The mucous membrane of the caeca in the case No. 25 presents a similar picture as in the previously described cases. In the chicken No. 24 postmortem examination gave negative results.

Parasitological control

In water, received from the rinsed contents of duodenum and jejunum, the presence of larvae was diagnosed in the cases 14 — 20, in numbers averagely from 2 — 4 specimens. In the smears from the mucus in cases 6 — 21 there were on the average 5 — 6 larvae. On the whole, the greatest numbers of larvae were found in the smears of mucus collected from the jejunum. In two cases the larvae were also found in the smears from the ileum.

In the smears from the caeca there occurred in about 75% of the cases *Heterakis gallinae* which were in a various degree of their development. It should be stressed that in these cases the lymphatic apparatus (tonsillae caecales) reacted very typically, manifested particularly in the cases No. 5 and 12.

Bacteriological control: the cultures from the examined material were negative.

Serological control (precipitation):

Serum of. chicken no	Antigen from *Ascaridia galli*	Antigen from *Heterakis gallinae*	Antigen from *Raillietina cesticillus*
6 after 2 min. in 40°C	−	+	+ −
7 „	−	+ +	−
10 „	+ −	+	+ −
12 „	−	+ +	−
13 „	−	+	+ −
17 after 5 min. in 40°C	+ −	+ +	−
20 „	+	+ −	−
24 „	−	−	−
25 „	+ −	+	+ −

Microscopic examinations

In the histological slides from duodenum, jejunum and ileum the picture of the lesions resemble those found in the I group, the difference being only in that the lesions are less regular and the appearance and disappearance of the tissue reaction are not so regular.

Case 5. Caeca: In the mucous membrane and the tonsilla caecalis there occur small necrotic foci. These observed under high magnification show that they include sometimes the gland tubes, which are distinctly enlarged. The lumen of the gland ducts is filled with acellular, uniformly stained mass of the body of the parasite which exerts pressure on the epithelium of the ductes and leads to its atrophy. The whole area is surrounded by a wall of cellular infiltration composed of lymphocytes, lymphoblasts and pseudoeosinophils, among which occur numerous fibroblasts. On the surface there occur numerous red blood corpuscles which reach also the lymphatic noduli.

Case 12. Caeca: In the central part of the focus of a dark violet colour there takes place calcification. The very abundant cellular infiltration of lymphocytes is displaced from the lymphatic tissue and pentrates into the mucous membrane. On the surface of the fungs-like „tonsilla" there are among the lymphocytes numerous erythrocytes.

In the histological preparations from the parenchymatous organs: heart, liver, kidneys, lungs and spleen no visible lesions were found.

Discussion

The chickens originated from one hatch. The I group of the chickens up to the moment of invasion was kept in isolation. The II group was kept up to 8 weeks on the farm together with other birds. In connection with this the possibility of a primary contact of the chickens with an unknown fauna of the biotype was taken into consideration, however, it was presumed that the eventual helminthiasis in this group of chickens will not attain 70%. For the evaluation of the tissue reaction caused by the artificial invasion of *Ascaris galli* the greatest value have above all the observations made on the I group. In the II group, however, that is in the group of chickens naturally invaded with *Heterakis gallinae* (Gmelin, 1790) and subsequently invaded with eggs of *Ascaris galli* (Schrank, 1788), there were possibilities to trace and compare the tissue reaction developing in the organism affected with primary invasion.

The chickens of the II group were invaded with a higher number of eggs because of the possibility of the existence of an anti-invasion resistance, connected on one side with the age of the chickens, on the other side — with allergy after the eventual primary invasion with helminths. As evident from the data in the literature, those moments may exert an essential influence on the artificial invasion and its positive result.

As the result of postmortem examinations of chickens of the I group it was found that a local and fairly strictly limited cellular reaction occurs exclusively within the section of the small intestine. The essential lesions were manifested by small ecchymoses, sometimes very numerously appearing, which included several villi or deeper layers and extended to the submucous membrane. The lesions were connected principally with the terminal part of duo-

denum and the initial part of jejunum. Besides the mentioned lesions there occurred also distinct softness of the mucous membrane and hyperplasia of the lymphatic noduli, particularly in the cases 8 — 14. It should be stressed that in all cases the amount of mucus was in duodenum considerably greater in comparison with the remaining sections of the small intestine.

On the whole distance of the small intestine, neither in the group I nor in the group II, a permanent connection of larvae with the mucous membrane was macrossopically observed. It was impossible to determine, whether this phenomenon could be related to the species of the host and racial resistance, or with the conditions of invasion, depending for instance on the season of the year.

Looking over the results of the microscopic examinations of the I group one can state that the observed reactions have to a major degree characteristics of a catarrhal inflammation which runs a more or less intense course. In first cases there was a preponderance of recessive lesions and vascular lesions, manifested principally by numerous extravasations (ecchymoses), swelling of the villi and sometimes their mucoid degeneration, necrobiosis and necrosis of the superficial layers of the mucous membrane and by small necrotic foci, usually connected with the presence of parasites. The picture was usually supplemented by the local hyperplasia of the lymphatic noduli. Between the lymphocytes, particularly near and around the necrotic foci, there occurred accumulations of pseudoeosinophils, but in the proper layer of the mucous membrane and at the base of the villi there occurred histiocytes.

In the later cases, in place of the regressing and subsiding cellular infiltrations and ecchymoses, there appeared in increasing numbers fibroblasts and histiocytes. There was a distinct change in the microscopical pictures, which was observed in cases 14 — 16. An expression of this change was the subsiding of the characteristics of the acute form of the process manifested in degenerative lesions and vascular changes and the appearance in part changes of the progressive nature (remotio et reparatio) in the form of the hyperplasia of histiocytes and fibroblasts. Many a time there was a lack of evidently manifested traces of the tissue reaction, what can be explained by complete regeneration of the mucous membrane together with its epithelium (regeneratio cum reepithelisatione, seu restitutio ad integrum).

In the not injured epithelium of the duodenum there were observed great numbers of goblet cells in an active state evidenced by the staining with mucocarmine. Besides this there was a tendency to mucous degeneration of the whole villi. This phenomenon was several times noticed in the control chickens.

The fragments of parasites were found exclusively in the villi or between them. They were located superficially, at the end of the duodenal loop and in the initial section of the jejunum; only in one case they occurred within the ileum (Meckel's diverticle).

In the microscopic picture of the Meckel's diverticle, in which during the postmortem examination an accumulation of the larvae *Ascardia galli* (10 specimens) was found, there was an extensive, superficial damage of the mucous membrane. The necrobiotic mucous membrane was separated from the remaining tissue. The muscular became thicker and the glandular tissue became hyperplastic what created a picture of an adenoma. This was undoubtedly related to the presence of the considerable number of parasites concentrated on a small area where they exerted an irritating effect. This isolated observation on the concentration of the larvae in the Meckel's diverticle offers no basis for the assumption that the invasion of young chickens takes place easier. However, it should be neverthelles remembered that in young chickens at the age of about 1 month this diverticle is usually open and later it gradually undergoes regressive changes, and in old hens it is represented in the form of a thickening of the wall of the intestine.

In the II group, in spite of the increase of the number of eggs of *Ascaridia galli* to 300, there occurred in the same sections of alimentary tract, as in the group I, an average number of 3 — 5 specimens of the parasite.

It can be assumed that the inhibition of the development of nematodes could be caused by various factors, such as the race, age (8 weeks), primary contact and invasion with larvae of *Heterakis gallinae*, which although connected with caeca could provoke a state of cellular defence readiness by way of an augmented allergic state (hypergia).

The possibility of primary sensitiveness is supported to a large by the microscopical pictures of the small intestines. They differ from the lesions found in the I group, because here we find an early appearance of the cellular hyperplasia of the histiocytary type

and hyperplastic lesions. Degenerative changes and vascular lesions, if present, were not so pronounced. Neither could be observed in this group the progress of the pathological process and its regression. The lessions of various intensity occurred in various periods of experiments.

In connection with the habitat of *Heterakis gallinae* it was found on postmortem examination that the presence of those parasites in the caeca causes a reaction on the side of the lymphatic system, the so called tonsilla caecalis, which undergo hyperplasia and become hyperaemic.

It was histopathologically confirmed that the picture of the numerous necrotic foci in the mucous membrane is similar to those usually observed in cases of parasitological processes.

The bacteriological examination of the groups of chickens was negative. This is an indication that the tissue reactions were caused by the larvae of parasites.

As seen from the serological tests the agglutination reaction of the examined sera was not specific. The positive reaction appeared not in accordance and not proportionally to the developing cellular changes and not to the time lapsing from the moment of invasion. The reaction was positive also in control birds, or was negative in experimental chickens at the time, when the expected result should be positive.

Conclusions

(1) Chickens of the I group at the age of 4 weeks became invaded with some resistance following the administration of the eggs of *Ascaridia galli* (Schrank, 1788). The course of invasion was not of a violent character. Undoubtedly on the mild course of invasion a decisive influence exerted the modest development of larvae, the sectional, local tissue reaction in intestines and the augmented production of the mucus.

(2) Neither in I group nor in II group could be observed any influence of the sex on the resistance or susceptibility of birds to the invasion.

(3) It was proved that the sphere of development of larvae includes jejunum and even ileum. The detection of a large concentration of larvae within Meckel's diverticle leads to the suspection that the larvae can successfully develop in the niches and diverticles

of the alimentary tract. It is possible that the conditions reigning within the duodenum, in view of the presence of the large amount of mucus, intensive peristaltic movements of the intestines and mechanical action of the intestinal contents "force" in some way the worm to searching and using such places as the Meckel's diverticulum or at least to the moving to such sections of the alimentary canal in which the production of the protective mucus is diminished. To the corroboration or negation of such a view it seems purposeful to conduct such studies on a larger material.

(4) The tissue reaction develops sectionally and in the peak phase, till the moment they start to regress, it is characterised by the presence of degenerative changes and vascular manifestations. The temporary relation of the larvae with the mucous membrane of the intestines was relatively loose and was limited to the superficial layers. Therefore it can be supposed that the larvae in their initial stadium of development grow in the environ close to the mucous membrane and in the chickens Sussex they do not affect the deeper layers of the intestine. Hyperplasia of the lymphocytes and pseudoeosinophils is a constant phenomenon. In the later period, that is on the 16 — 18 day following the invasion, there occurs a hyperplasia of cells composed mainly of histiocytes, sometimes fibroblasts as the reparation phenomenon. Usually, however, the mucous membrane regains its original condition because restitutio ad integrum takes place.

(5) In the II group of chickens (8 weeks) the primary invasion did not inhibit the development of the artificially introduced eggs of *Ascaridia galli*, in spite of that 300 eggs were employed; the development of larvae was relatively insignificant. The sphere of parasitizing was the same as in the I group. The tissue reaction indicated an early irritation of the RES and cellular hyperplasia. This was undoubtedly related to the primary invasion of the chickens with the environmental fauna.

(6) The histological changes within the mucous membrane of the caeca are typical to the tissue reaction caused by the presence of *Heterakis gallinae*.

(7) The serological tests may indicate a not specific reaction of the sera of the examined chickens.

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STRESZCZENIE

Celem niniejszej pracy jest analiza zmian morfotycznych, makro- i mikroskopowych u kurcząt rasy Sussex, zarażonych doświadczalnie glistą ptasią (*Ascaridia galli* Schrank, 1788), ze szczególnym uwzględnieniem zachowania się odczynu układu siateczkowo-śródbłonkowego.

Badania przeprowadzono na dwóch grupach kurcząt, liczących po 25 sztuk, w tym po 2 sztuki kontrolne. I grupie (wiek 4 tygodnie) wprowadzono około 150 jaj *Ascaridia galli* za pomocą sondy przełykowej, bezpośrednio do wola. Grupie II (wiek 8 tygodni) wprowadzono ok. 300 jajeczek. Obie grupy kurcząt uległy sztucznemu zarażeniu, jednakże obraz kliniczny nie miał charakteru jawnego. Po 4 dniach od chwili zarażenia zabijano po jednym kurczęciu dziennie i przeprowadzono sekcje anatomo-patologiczne. Z pobranych wycinków przewodu pokarmowego i narządów miąższowych sporządzano preparaty histopatologiczne. Dokumentację stanowią mikrofotografie (12 zdjęć).

Z pracy wyciągnięto następujące wnioski:

1. Kurczęta grupy I uległy dość opornie zarażeniu, a przebieg zarażenia nie miał charakteru burzliwego.

2. Nie stwierdzono roli płci w oporności lub podatności na inwazję.

3. Przekonano się, że strefa rozwoju larw oraz ich pasożytowania obejmuje swym zasięgiem jelito czcze, a nawet biodrowe. Wykrycie dużego skupiska larw obrębie zachyłka Meckela nasuwa podejrzenie, że larwy mogą rozwijać się pomyślnie w niszach i zachyłkach przewodu pokarmowego.

4. Odczyn tkankowy rozwija się odcinkami i w fazie szczytowej do momentu przełomu cechuje się obecnością zmian wstecznych i naczyniowych. Czasowy związek larw z błoną śluzową jelit był stosunkowo luźny i ograniczał się do powierzchownych jej warstw. Dlatego należy przypuszczać, iż larwy w początkowym stadium rozwoju wzrastają w środowisku tzw. przyśluzówkowym. Rozplem limfocytów i pseudoeozynofilów jest stały. W okresie późniejszym, tj. w 16—18 dniu po zarażeniu, pojawia się rozplem komórkowy złożony z histocytów, niekiedy fibroblastów, jako zjawisko naprawcze. Zwykle jednak następuje powrót błony śluzowej do stanu pierwotnego.

5. W grupie II kurcząt pierwotne zarobaczenie nie wpłynęło hamująco na rozwój wprowadzonych jaj *Ascaridia galli*, rozwój larw był stosunkowo nieznaczny. Strefa pasożytowania pokrywała się ze strefą stwierdzoną w grupie I. Odczyn tkankowy wykazywał wczesne pobudzenie uść i rozplem komórkowy, co miało niewątpliwie związek z pierwotnym zarażeniem się kurcząt fauną środowiskową.

6. Zmiany histologiczne w obrębie błony śluzowej jelit ślepych były typowe dla odczynu tkankowego spowodowanego obecnością pasożytów *Heterakis gallinae*.

7. Przeprowadzone odczyny serologiczne mogą przekonywać o nieswoistym oddziaływaniu surowic badanych kurcząt.

EXPLANATION OF PLATES

PLATE I

Phot. 1. Duodenum. Villi long and narrow, entangled, with distinctly marked reticular stroma of the proper layer. Small superficial damages, desquamated epithelium stuck by mucus.

Phot. 2. Duodenum. Superficial dying away and obliteration of the proper structure of villi. Lack of epithelium and dispersed lymphocytary infiltration, here and there pseudoeosinophils.

Phot. 3. Passage from duodenum into jejunum. Villi swollen, structure not changed. Insignificant lymphocytary hyperplasia and small extravasation of erythrocytes.

Phot. 4. Duodenum. Local damage of villi reaching 1/2 of their length. Considerable haemorrhages and (on the left) lymphocytary infiltration.

PLATE II

Phot. 5. Terminal part of duodenum. Total obliteration of the proper structure of villi. Scarse histiocytary hyperplasia, superficial necrosis and separating of deadened parts.

Phot. 6. Jejunum. Separating of deadened parts of villi, stressed by haemorrhages.

Phot. 7. Jejunum. At the base of villi, in widened gland ducts, there are fragments of parasites. In the centre a focal lymphocytic and pseudoeosinophilic infiltration.

Phot. 8. Duodenum. Necrotic focus in 1/2 of height of mucous membrane, beside a widened gland duct filled up with content. Scarse cell reaction.

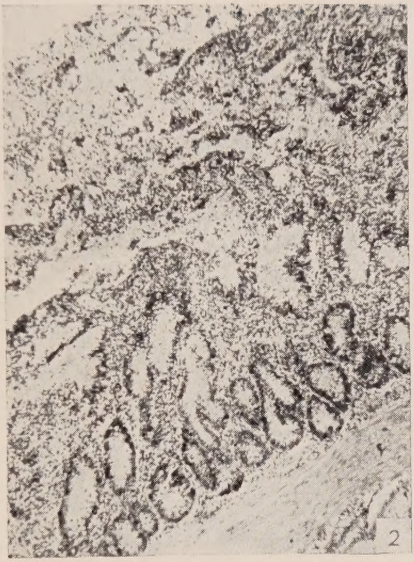
PLATE III

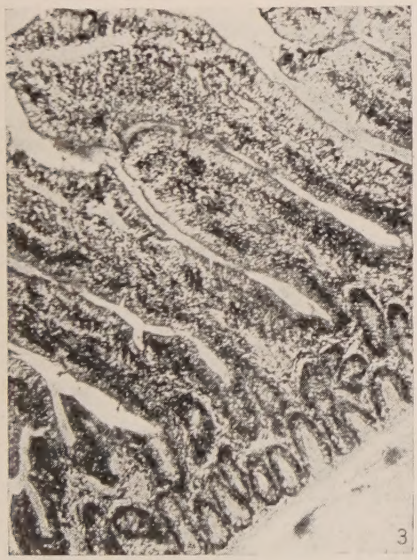
Phot. 9. Terminal part of duodenum. Total obliteration of the structure of villi. Histiocytary hyperplasia and lymphocytary infiltration. Separating of deadened parts.

Phot. 10. Meckel's diverticle. Obliteration of the proper structure of mucous membrane and its superficial damage. Hyperplasia of muscular layer and gland tissue, separated by connective tissue. The remaining glandular tissue infiltrated by lymphocytes and pseudoeosinophils.

Phot. 11. Caecum. In the sectioned gland duct a fragment of parasite, surrounded by cellular infiltration.

Phot. 12. Caecum. In distinctly widened gland duct a calcificated parasite present, glandular epithelium atrophied. Round about a peculiar cellular infiltration.





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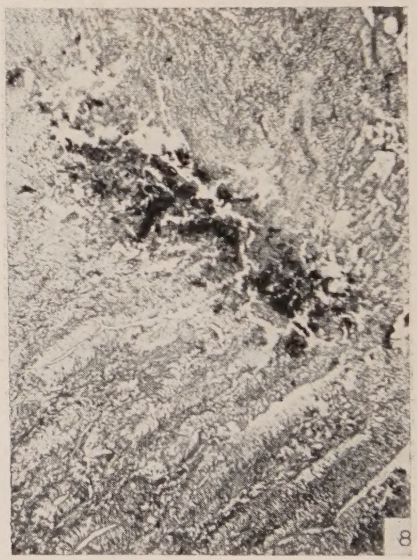
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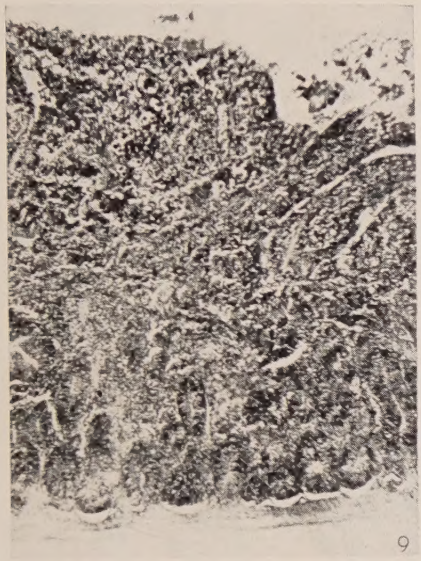

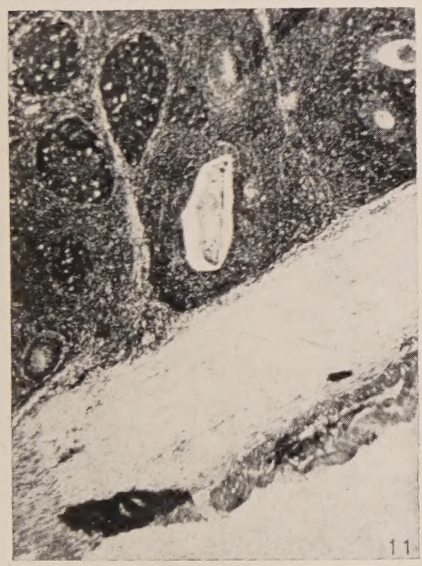

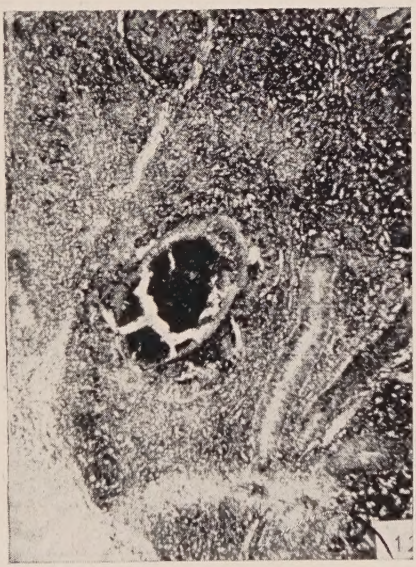

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